## CLAIMS

What is claimed is:

1. A method of filtering noise from a mixed sound signal to obtained a filtered target signal, comprising the steps of:

inputting the mixed signal through a pair of microphones into a first channel and a second channel;

separately Fourier transforming each said mixed signal into the frequency domain;

computing a signal short-time spectral amplitude $|\hat{S}|$ from said transformed signals;

computing a signal short-time spectral complex exponential $e^{i \arg(S)}$ from said transformed signals, where $\arg(S)$ is the phase of the target signal in the frequency domain;

computing said target signal $S$ in the frequency domain from said spectral amplitude and said complex exponential.

2. The method of claim 1 wherein said target signal $S$ in the frequency domain is inverse Fourier transformed to produce a filtered target signal $s$ in the time domain.

3. The method of claim 1 further comprising the step of computing a spectral power matrix and using said spectral power matrix to compute said spectral amplitude and said spectral complex exponential.

4. The method of claim 3 wherein said spectral power matrix is computed by spectral channel subtraction.

5. The method of claim 3 wherein said signal short-time spectral amplitude is computed by the estimation equation

$$|\hat{S}| = \mathbf{E}\left[|S| \;|X_1, X_2\right] = \frac{\sqrt{\pi}}{2}\frac{1}{\sqrt{C_1}}\exp\left(-\frac{C_2^2}{8C_1}\right)\left[1 + \frac{C_2^2}{4C_1}I_0\left(\frac{C_2^2}{8C_1}\right) + \frac{C_2^2}{4C_1}I_1\left(\frac{C_2^2}{8C_2}\right)\right]$$

where $I_0(z) = \frac{1}{2\pi}\int_0^{2\pi}\exp(z\cos\beta)d\beta$, $I_n(1) = \frac{1}{2\pi}\int_0^{2\pi}\cos(\beta)\exp(z\cos\beta)d\beta$,

$$C_1 = \frac{1}{\rho_s} + \frac{1}{\det R_n}\left(R_{22} + R_{11}|K|^2 - KR_{12} - \bar{K}R_{21}\right),\; C_2 = \frac{2}{\det R_n}\left|\bar{X}_1 R_{22} + \bar{X}_2 K R_{11} - X_2 R_{12} - X_1 \bar{K} R_{21}\right|,$$

$X_1$ and $X_2$ are the Fourier transformed first and second signals respectively, $R_{nm}$ are elements of said spectral power matrix, and K is a constant.

6. The method of claim 3 wherein said signal short-time spectral complex exponential is computed by the estimation equation

$$z \equiv e^{i\,\widehat{\arg}(S)} = \frac{R_{22}X_1 + R_{11}\bar{K}X_2 - R_{21}\bar{K}X_1 - R_{12}X_2}{\left|R_{22}X_1 + R_{11}\bar{K}X_2 - R_{21}\bar{K}X_1 - R_{12}X_2\right|}$$

7. The method of claim 3 wherein said signal short-time spectral complex exponential is computed by the estimation equation

$$z \equiv e^{i\,\widehat{\arg}(S)} = \frac{R_{22}X_1 + R_{11}\bar{K}X_2 - R_{21}\bar{K}X_1 - R_{12}X_2}{\left|R_{22}X_1 + R_{11}\bar{K}X_2 - R_{21}\bar{K}X_1 - R_{12}X_2\right|}$$

8. The method of claim 7 wherein said target signal S in the frequency domain is computed by the equation

$$S = zA$$

9. The method of claim 1 wherein said target signal is computed by multiplying said signal short-time spectral amplitude by said signal short-time spectral complex exponential.

10 The method of claim 1 further comprising the step of calibrating a function K(ω), said function equal to a ratio of one said Fourier transformed signal to the other, by the estimation equation

$$K(\omega) = \frac{\sum_{t=1}^{F} X_2^c(l,\omega)\overline{X_1^c(l.\omega)}}{\sum_{t=1}^{F} \left|X_1^c(l,\omega)\right|^2}$$

where $X_1^c(l,\omega), X_2^c(l,\omega)$ represents the discrete windowed Fourier transform at frequency ω, and time-frame index $l$ of the transformed signals $x_1^c$, $x_2^c$ within time frame $c$.

11 An apparatus for filtering noise from a mixed sound signal to obtained a filtered target signal, comprising:

a pair of input channels for receiving mixed signals from a pair of microphones;

a pair of Fourier transformers, each receiving a mixed signal from one of said channels and Fourier transforming said mixed signal into a transformed signal in the frequency domain;

a filter, said filter receiving said transformed signals and computing a signal short-time spectral amplitude $|\hat{S}|$ and a signal short-time spectral complex exponential $e^{i \arg(S)}$ from said transformed signals, where arg($S$) is the phase of the target signal in the frequency domain; and

Wherein said filter computes said target signal S in the frequency domain from said spectral amplitude and said complex exponential.

12. The apparatus of claim 11 further comprising a spectral power matrix updater, said updater receiving said transformed signals and computing therefrom a spectral power matrix, and outputting said spectral power matrix to said filter.

13. The apparatus of claim 11 further comprising an inverse Fourier transformer receiving said target signal S in the frequency domain and inverse Fourier transforming said target signal into a filtered target signal $s$ in the time domain.

14. A program storage device readable by machine, tangibly embodying a program of instructions executable by machine to perform method steps for filtering noise from a mixed sound signal to obtained a filtered target signal, said method steps comprising:

inputting the mixed signal through a pair of microphones into a first channel and a second channel;

separately Fourier transforming each said mixed signal into the frequency domain;

computing a signal short-time spectral amplitude $|\hat{S}|$ from said transformed signals;

computing a signal short-time spectral complex exponential $e^{i\arg(S)}$ from said transformed signals, where $\arg(S)$ is the phase of the target signal in the frequency domain;

computing said target signal $S$ in the frequency domain from said spectral amplitude and said complex exponential.

15. The device of claim 14 wherein said target signal $S$ in the frequency domain is inverse Fourier transformed to produce a filtered target signal $s$ in the time domain.

16. The device of claim 14 further comprising the step of computing a spectral power matrix and using said spectral power matrix to compute said spectral amplitude and said spectral complex exponential.

17. The device of claim 16 wherein said spectral power matrix is computed by spectral channel subtraction.

18. The device of claim 16 wherein said signal short-time spectral amplitude is computed by the estimation equation

$$|\hat{S}| = \mathbf{E}\big[|S| \mid X_1, X_2\big] = \frac{\sqrt{\pi}}{2}\frac{1}{\sqrt{C_1}}\exp\left(-\frac{C_2^2}{8C_1}\right)\left[1 + \frac{C_2^2}{4C_1} I_0\left(\frac{C_2^2}{8C_1}\right) + \frac{C_2^2}{4C_1} I_1\left(\frac{C_2^2}{8C_2}\right)\right]$$

where $I_0(z) = \frac{1}{2\pi}\int_0^{2\pi}\exp(z\cos\beta)d\beta$ , $I_n(1) = \frac{1}{2\pi}\int_0^{2\pi}\cos(\beta)\exp(z\cos\beta)d\beta$ ,

$C_1 = \frac{1}{\rho_s} + \frac{1}{\det R_n}\left(R_{22} + R_{11}|K|^2 - KR_{12} - \bar{K}R_{21}\right)$, $C_2 = \frac{2}{\det R_n}\left|\bar{X}_1 R_{22} + \bar{X}_2 K R_{11} - X_2 R_{12} - X_1 \bar{K} R_{21}\right|$,

$X_1$ and $X_2$ are the Fourier transformed first and second signals respectively, $R_{nm}$ are elements of said spectral power matrix, and K is a constant.

19. The device of claim 16 wherein said signal short-time spectral complex exponential is computed by the estimation equation

$$z \equiv e^{i\,\mathrm{a\hat{r}g}(S)} = \frac{R_{22}X_1 + R_{11}\bar{K}X_2 - R_{21}\bar{K}X_1 - R_{12}X_2}{\left|R_{22}X_1 + R_{11}\bar{K}X_2 - R_{21}\bar{K}X_1 - R_{12}X_2\right|}$$

20. The device of claim 16 wherein said signal short-time spectral complex exponential is computed by the estimation equation

$$z \equiv e^{i\,\hat{\arg}(S)} = \frac{R_{22}X_1 + R_{11}\bar{K}X_2 - R_{21}\bar{K}X_1 - R_{12}X_2}{\left|R_{22}X_1 + R_{11}\bar{K}X_2 - R_{21}\bar{K}X_1 - R_{12}X_2\right|}$$

21. The device of claim 20 wherein said target signal S in the frequency domain is computed by the equation

$$S = zA$$

22. The device of claim 14 wherein said target signal is computed by multiplying said signal short-time spectral amplitude by said signal short-time spectral complex exponential.

23. The device of claim 14 further comprising the step of calibrating a function K(ω), said function equal to a ratio of one said Fourier transformed signal to the other, by the estimation equation

$$K(\omega) = \frac{\sum_{t=1}^{F} X_2^c(l,\omega)\overline{X_1^c(l.\omega)}}{\sum_{t=1}^{F} \left|X_1^c(l,\omega)\right|^2}$$

where $X_1^c(l,\omega), X_2^c(l,\omega)$ represents the discrete windowed Fourier transform at frequency ω, and time-frame index $l$ of the transformed signals $x_1^c$, $x_2^c$ within time frame $c$.

24. The device of claim 14 further comprising the step of updating a function *K(ω)*, said function equal to a ratio of one said Fourier transformed signal to the other, said updating effected by using a linear combination between a previous value for *K(ω)* at a time *t*-1 and a current value for *K(ω)* at a time *t* according to the equation

$$K^t(\omega) = (1-\alpha)K^{t-1}(\omega) + \alpha K(\omega)$$

where α is an adaptation rate.

## ABSTRACT OF THE INVENTION

Disclosed is an apparatus for and a method of filtering noise from a mixed sound signal to obtained a filtered target signal, comprising the steps of inputting the mixed signal through a pair of microphones into a first channel and a second channel, separately Fourier transforming each said mixed signal into the frequency domain, computing a signal short-time spectral amplitude $|\hat{S}|$ from said transformed signals, computing a signal short-time spectral complex exponential $e^{i \arg(S)}$ from said transformed signals, where $\arg(S)$ is the phase of the target signal in the frequency domain, computing said target signal $S$ in the frequency domain from said spectral amplitude and said complex exponential.